FRD Activities Report
June 2003

Research Programs

Joint Urban 2003

In late June the majority of the FRD staff arrived in Oklahoma City for the field deployment portion of the Joint Urban 2003 campaign. It was no small feat in getting there. First, 67 new bag samplers and 325 new plastic cartridges of a completely new design were conceived, fabricated, and built entirely with FRD ingenuity. The existing 140 bag samplers and 650 paper cartridges were also readied for deployment. This effort alone resulted in the installation and cleaning of more than 11,000 sample bags! All of the samplers and cartridges, together with four newly built FRD gas chromatographs, ten realtime SF_6 analyzers, and an SF_6 release mechanism were packed into two moving vans and one passenger van for the trip. Two of the vans also towed a sodar and components. All of this equipment was then driven 1500 miles across the Rocky Mountains and the Great Plains to Oklahoma City.

After our arrival, we had six days to completely unpack the vans, install the ten realtime analyzers in ten rental vans, and entirely recreate our SF_6 analysis laboratory in a new location. We also had to prepare the release mechanism and install more than 225 sampler hangers at three meters above the ground on light and signal poles. (These hangers provide a secure place to install the bag samplers where the curious aren't able to tamper with them.) All of these tasks had to be accomplished with nearly all of the staff being completely unfamiliar with Oklahoma City. As it turned out, we completed the tasks in only four days with only eight people, leaving us a buffer of two days to tweak and tune instruments!

Figure 1. The 10 realtime analyzer vans and associated FRD crew in front of the bag sampler storage facility in Oklahoma City.

Figure 2. FRD tracer analysis facility and personnel in Oklahoma City.

FRD is not alone in Oklahoma City, although we have received the lion's share of the $6.5 million budget allocated for this project. ARL's Atmospheric Turbulence and Diffusion Division is also represented, as well as Argonne National Laboratory, Pacific Northwest National Laboratory, Lawrence Livermore National Laboratory, Lawrence Berkeley National Laboratory, Los Alamos National Laboratory, U.S. Army Dugway Proving Ground, Aberdeen Proving Ground, Army Research Laboratory, the University of Oklahoma, the University of Utah, and Arizona State University, and so forth. This list is not all-inclusive, but gives some flavor of the magnitude of the project and its visibility.

The first Intensive Observation Period (IOP) was conducted during the day on 29 June. FRD's bag samplers were deployed on building tops, in the underground tunnel system similar to that of Crystal City, as well as on power and light poles. Nine of FRD's SF_6 analyzers were deployed in stationary positions in the downtown area between the tall buildings to measure instantaneous concentrations in the street canyons. One SF_6 analyzer was used in a mobile mode to provide realtime updates of the SF_6 plume position and concentration. Preliminary results show a substantial amount of the tracer material being lifted to at least building-top height, as shown in the accompanying figure. Nine more IOPs are scheduled to occur in the month of July before the crew can pack up and leave for home.

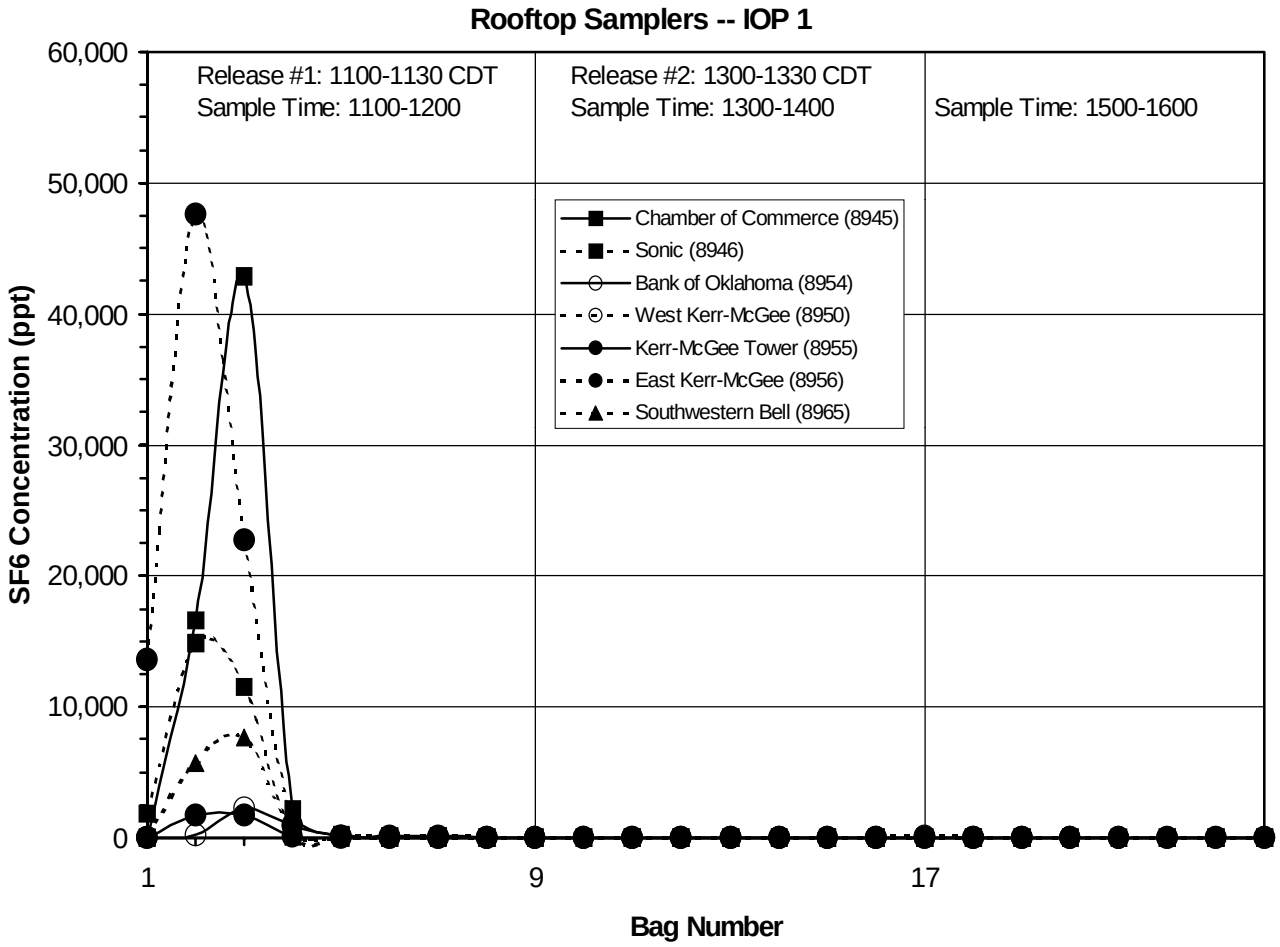

Figure 3. Tracer concentration measured by rooftop samplers in IOP 1.

CLAST-High

The BAT instrument package and data system were re-installed on N43 in early June in preparation for the upcoming hurricane season. Included in the install were the BAT probe, an IRGA, and an Everest IR temperature sensor along with the data system computer/display unit. The Everest IR sensor was a new installation as it was a low priority item during last year's hurricane flights. This installation required the fabrication of a new aluminum coupler that is used to attach the BAT probe to the existing nose boom on the P3. Also, the aluminum hemisphere to be used in this year's flights was modified from earlier designs. It

Figure 4. BAT probe mounted on the nose boom of NOAA P3 (N43). The probe is the center piece for obtaining flux measurements in hurricane dry slots as part of CBLAST-High.

is expected to be more robust and is easier/less expensive to reproduce than the proto-type aluminum hemisphere. Ground tests were conducted to assure instruments were operating correctly. Flight tests are scheduled for late July/early August. These tests will include both rain/graupel flights and calibration maneuvers to determine the flow coefficients. (Jeff.French@noaa.gov)

CBLAST-Low

Work continues on the analysis of the CBLAST-Low data. A literature search was done for papers based on comparisons between results from the TOGA-COARE algorithm and experimental results. The COARE v3 algorithm was converted to IDL. Comparison plots between the COARE algorithm results without wave effects versus the LongEZ eddy correlation results were generated. Generally the heat fluxes showed good agreement along with u_*. However, z_0, C_{dn}, T_* and q_* did not show as good agreement. Currently work is directed towards computing the wave age so comparisons between the COARE algorithm with wave effects and the LongEZ data can be done. (Tami Grimmett, Jeff French)

Refractive Turbulence

Work continues on analysis of data from last year's campaign in Adelaide, Australia. The data have been reduced and are presently being used to produce various co- and cross-spectra for analysis of CT^2 and Cn^2. Work on this portion of the analysis will continue through July. (Jeff.French@noaa.gov)

ET Probe

Intercomparisons are now under way between the ET probe data collected on 15 May 2003 and the data from the FRD sonic anemometer at INEEL. The ET probe was set up about 50 m from the sonic during these tests. The first issue that was dealt with was the proper rotation of the sonic and ET probe coordinate systems so that the *x* axes point downwind. Currently, the software used with the sonic anemometer uses a double rotation of the coordinate system. The first rotation forces the mean *v* component to zero, and the second forces the mean *w* component to zero. This double rotation is probably sufficient for the sonic, which was aligned fairly carefully during installation. However, the ET probe was mounted on a truck, so the vertical alignment was not very precise. It was therefore decided to apply a triple rotation to both the ET probe and sonic data. The third rotation forces the covariance of *v* and *w* to zero. Software is being written to apply the triple rotation to both sets of data. There is an alternate approach to aligning sonic data that fits a plane surface to the 3D wind vector, but this requires longer-term data from various wind directions, which are not available with the ET probe.

Another issue important for the ET probe and sonic comparison is the computation of confidence intervals for the turbulence statistics. Differences between the statistics from the two sensors may not be significant if the confidence intervals are wide. The problem here is that standard statistical tests assume all the samples are independent, when this is demonstrably untrue for turbulence data. An alternate approach based on Bayesian statistics called Markov Chain Monte Carlo

(MCMC) seems to show some promise in avoiding or reducing these problems. Some tests of the MCMC approach have been conducted with the sonic data from the site. In these tests, an autoregressive model was used for the turbulence time series, so the resulting statistics account the lack of independence between the samples. The MCMC approach also allows one to assume the fluctuations have a skewed distribution rather than the Normal distribution used for most statistical tests. Moreover, the MCMC approach can account for the effects of so-called nuisance parameters, such as the slope and offset of a possible trend in the data. The confidence intervals based on the MCMC modeling are generally wider than those produced by the standard statistical tests. (Richard.Eckman@noaa.gov)

Rain In Cumulus over the Ocean (RICO)

A proposal was submitted to the National Science Foundation, Physical Meteorology Program to investigate the initiation of precipitation and maintenance of cloud clusters in trade-wind cumuli. This proposal is a joint effort between ARL and the University of Wyoming to gain a better understanding of the role these clouds play in climate and global energy balance. Our proposal is linked to the RICO project which is a multi-institution project bringing together scientists from domestic and foreign universities, private industry, and government agencies to better understand the nature of trade wind cumuli. (Jeff.French@noaa.gov)

Cooperative Research with INEEL

Emergency Operations Center (EOC)

On June 4 Kirk Clawson and Brad Reese participated in an exercise at the Emergency Operations Center.

On June 25 a "tabletop" exercise was held at the INEEL EOC to explore potential accident scenarios and the response to them. Various planning-support staff from the EOC attended to exercise, including a FRD representative. These exercises do not involve an actual activation of the EOC; they are intended to ensure that the EOC staff has the resources required to deal with various scenarios that could occur at INEEL. (Richard.Eckman@noaa.gov)

INEEL Support

Each year around this time there is usually a burst of activity regarding wildfire preparedness, and this year is no exception. The INEEL Fire Marshal and Deputy Fire Marshal visited FRD in June to discuss the use of one or more of the INEEL Mesonet towers for fire-weather support. Specifically, they would like to see the towers included in the Weather Information Management System (WIMS). Data from WIMS is used in the National Fire Danger Rating System (NFDRS) to generate fire-weather maps for the U.S., including the adjective fire danger ratings (low, medium, high, etc.) often seen on roadway signs. Initial contacts with the WIMS support staff indicate that it will not be easy to get the Mesonet towers included. WIMS is primarily set up to use data from the Remote Automated Weather Stations (RAWS) operated by the BLM and other

agencies. There does not appear to be any mechanism for ingesting data from other sources, other than manual data entry. This is rather unfortunate, because it appears that many of the data holes seen in the fire-weather maps could be filled by towers from other networks. Investigations into this issue are continuing. (Richard.Eckman@noaa.gov)

A search was also conducted for any new software that has recently become available for wildfire modeling. FRD has a simple program to estimate fire spread and intensity based on user inputs of wind speed and fuel moisture. It uses the same algorithms as in the BEHAVE model that has been around for many years. A new BEHAVE PLUS model is now available, but it is currently just the old BEHAVE algorithms with a Windows graphical interface. The FRD program was upgraded, however, to include some newer fuel models from the NFDRS. It now provides outputs for NFDRS fuel models L (grassland) and T (sagebrush). (Richard.Eckman@noaa.gov)

Other Activities

Personnel

FRD employees were shocked and saddened to learn of the sudden death of Brad Reese's wife, Brenda, in a tragic automobile accident on June 12. Brad is an electronic engineer on the staff. Brenda was known and admired by the FRD group, and she will be missed. Brad and Brenda have three children ranging in age from 8 to 13.

Travel

Jeff French, June 3-6, to Tampa, Florida for instrument install on P-3 for Hurricane Project

Roger Carter, Shane Beard and Tom Strong, June 20, to Oklahoma City for the Joint Urban 2003 Field Project

Kirk Clawson, June 22, to Oklahoma City for the Joint Urban 2003 Field Project

Debbie Lacroix, June 23, to Oklahoma City for the Joint Urban 2003 Field Project

Tom Watson and Neil Hukari, June 25, to Oklahoma City for the Joint Urban 2003 Field Project